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- (72) Inventor: DAGTAS, Serhan; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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(54) Title: SYSTEM AND METHOD FOR PLAYBACK OF VIDEO WITH CLOSED CAPTIONED TEXT

(57) Abstract: There is disclosed a video frame grabber capable of capturing a plurality of video frames from a played-back video signal during fast forward mode and reverse mode. A closed caption text detector is provided that is capable of detecting closed caption text in the played-back video signal. A memory is provided for storing the detected closed caption text and a plurality of key frames. The key frames comprise selected ones captured by the video frame grabber corresponding to detected closed caption text. A video processor retrieves a line of closed caption text and at least one key frame corresponding to the first line of closed caption text and displays the line of closed caption text with the key frame on the display screen.

System and method for playback of video with closed captioned text

TECHNICAL FIELD OF THE INVENTION

The present invention is directed, in general, to video playback devices and more specifically, to a system for displaying closed caption text and related video in fast forward and reverse modes.

5

BACKGROUND OF THE INVENTION

A wide variety of video playback devices are available in the marketplace. Most people own, or are familiar with, a video cassette recorder (VCR), also referred to as a video tape recorder (VTR). More recently, video recorders that use computer magnetic hard disks rather than magnetic cassette tapes to store video programs have appeared in the market. For example, the ReplayTVJ recorder and the TiVOJ recorder digitally record television programs on hard disk drives using, for example, MPEG-2 compression. Additionally, some video playback devices may record on a readable/writable, digital versatile disk (DVD) rather than a magnetic disk.

15 Closed captioning service is widely used on television programs to provide textual transcripts for the audio speech segments. Viewers in a noisy environment and hearing impaired viewers find this feature especially useful. Text is usually displayed in a box in the lower portion of a television screen. After recording a broadcast, a user may wish to locate a point or segment within the tape or disk recording to view. The user may wish to skip a commercial or find a desired scene in the recorded broadcast. The traditional method for locating a segment is through "fast forward" and "rewind" (both considered a fast play mode) which accelerates the video information in the forward or backward direction, respectively.

25 In traditional VCRs as well as digital playback devices, the closed captioning feature is usually disabled and at most, only a sample of frames may be displayed at a high rate during fast forward or rewind mode. This prevents handicapped users from accessing the textual information as well as imposing a waste of an important and valuable source of content that may enhance browsing quality of the video.

There is therefore a need in the art for a system for viewing text during fast forward and rewind. There is a further need in the art for synchronizing closed caption text with video frames during fast play modes.

5 SUMMARY OF THE INVENTION

To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide, for use in a video recorder utilizing recording tape, hard disk or solid state memory, a system and method for display of closed caption text during fast play. There is disclosed a video frame grabber capable of capturing a plurality of
10 video frames from a played-back video signal during fast forward mode and reverse mode. A closed caption text detector is provided that is capable of detecting closed caption text in the played-back video signal. A memory is provided for storing the detected closed caption text and a plurality of key frames. The key frames comprise selected ones captured by the video frame grabber corresponding to detected closed caption text. A video processor retrieves a
15 line of closed caption text and at least one key frame corresponding to the first line of closed caption text and displays the line of closed caption text with the key frame on the display screen.

According to an advantageous embodiment of the present invention wherein the video processor is capable of displaying a plurality of lines of closed caption text in a
20 selected window on the display screen.

According to one embodiment of the present invention, the video processor is capable of scrolling the plurality of lines of closed caption text in the selected window on the display screen.

According to another embodiment of the present invention, the video
25 processor is capable of displaying a first key frame in a first portion of the display screen and a second key frame in a second portion of the display screen.

According to yet another embodiment of the present invention, the video processor is capable of displaying the first key frame in the first portion of the display screen when the first line of closed caption line text appears in a selected window on the display
30 screen.

According to still another embodiment of the present invention, the video processor is capable of displaying the first key frame in the second portion of the display screen when the first line of closed caption line text scrolls to a new position in the selected window on the display screen.

According to still yet another embodiment of the present invention, the video processor is capable of displaying lines of closed caption text and key frames on the display screen at a variable rate determined by commands received from a user of the video play back device.

5 The foregoing has outlined rather broadly the features and technical advantages of the present invention so that those skilled in the art may better understand the detailed description of the invention that follows. Additional features and advantages of the invention will be described hereinafter that form the subject of the claims of the invention. Those skilled in the art should appreciate that they may readily use the conception and the
10 specific embodiment disclosed as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the invention in its broadest form.

 Before undertaking the DETAILED DESCRIPTION, it may be advantageous
15 to set forth definitions of certain words and phrases used throughout this patent document: the terms "include" and "comprise," as well as derivatives thereof, mean inclusion without limitation; the term "or," is inclusive, meaning and/or; the phrases "associated with" and "associated therewith," as well as derivatives thereof, may mean to include, be included
20 within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, or the like; and the term "controller" means any device, system or part thereof that controls at least one operation, such a device may be implemented in hardware, firmware or software, or some combination of at least two of the same. It should be noted that the functionality associated with any particular controller may be
25 centralized or distributed, whether locally or remotely. In particular, a controller may comprise one or more data processors, and associated input/output devices and memory, that execute one or more application programs and/or an operating system program. Definitions for certain words and phrases are provided throughout this patent document, those of ordinary skill in the art should understand that in many, if not most instances, such
30 definitions apply to prior, as well as future uses of such defined words and phrases.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, wherein like numbers designate like objects, and in which:

FIGURE 1 illustrates an exemplary video playback device and a television set
5 according to one embodiment of the present invention;

FIGURE 2 illustrates in greater detail the exemplary video playback device according to one embodiment of the present invention;

FIGURE 3 illustrates a television screen on which closed caption text and associated video frames are displayed according to one embodiment of the present invention;

10 FIGURE 4 illustrates the contents of the closed caption memory in the exemplary video playback device according to one embodiment of the present invention; and

FIGURE 5 is a flow diagram illustrating the operation of the exemplary video playback device according to one embodiment of the present invention.

15 DETAILED DESCRIPTION OF THE INVENTION

FIGURES 1 through 5, discussed below, and the various embodiments used to describe the principles of the present invention in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the invention. Those skilled in the art will understand that the principles of the present invention may be
20 implemented in any suitably arranged video playback device.

FIGURE 1 illustrates exemplary video playback device 150 and television set 105 according to one embodiment of the present invention. Video playback device 150 receives incoming television signals from an external source, such as a cable television service provider (Cable Co.), a local antenna, the Internet, or a DVD or VHS tape player, and
25 transmits a viewer-selected channel to television set 105. In RECORD mode, video playback device 150 may demodulate an incoming radio frequency (RF) television signal to produce a baseband video signal that is recorded and stored on a storage medium within or connected to video playback device 150. In PLAY mode, video playback device 150 reads a stored baseband video signal (i.e., program) selected by the user from the storage medium and
30 transmits it to television set 105.

For example, if video playback device 150 is a video cassette recorder (VCR), also referred to as a video tape recorder (VTR), video playback device 150 stores and retrieves the incoming television signals to and from a magnetic cassette tape. If video playback device 150 is a disk drive-based device, such as a ReplayTVJ recorder or a TiVOJ

recorder, video playback device 150 stores and retrieves the incoming television signals to and from a computer magnetic hard disk rather than a magnetic cassette tape. In still other embodiments, video playback device 150 may store and retrieve from a local read/write (R/W) digital versatile disk (DVD) or R/W CD-ROM. Thus, the local storage medium may
5 be fixed (i.e., hard disk drive) or removable (i.e., DVD, CD-ROM).

Video playback device 150 comprises infrared (IR) sensor 160 that receives commands (such as Channel Up, Channel Down, Volume Up, Volume Down, Record, Play, Fast Forward (FF), Reverse, and the like) from a remote control device operated by the viewer. Television set 105 is a conventional television comprising screen 110, infrared (IR)
10 sensor 115, and one or more manual controls 120 (indicated by a dotted line). IR sensor 115 also receives commands (such as volume up, volume down, power ON/OFF) from a remote control device operated by the viewer.

It should be noted that video playback device 150 is not limited to receiving a particular type of incoming television signal from a particular type of source. As noted
15 above, the external source may be a cable service provider, a conventional RF broadcast antenna, a satellite dish, an Internet connection, or another local storage device, such as a DVD player or a VHS tape player. In some embodiments, video playback device 150 may not even be able to record, but may be limited to playing back television signals that are retrieved from a removable DVD or CD-ROM. Thus, the incoming signal may be a digital
20 signal, an analog signal, or Internet protocol (IP) packets. However, for the purposes of simplicity and clarity in explaining the principles of the present invention, the descriptions that follow shall generally be directed to an embodiment in which video playback device 150 receives incoming television signals (analog and/or digital) from a cable service provider. Nonetheless, those skilled in the art will understand that the principles of the present
25 invention may readily be adapted for use with wireless broadcast television signals, local storage systems, an incoming stream of IP packets containing MPEG data, and the like.

FIGURE 2 illustrates exemplary video playback device 150 in greater detail according to one embodiment of the present invention. Video playback device 150 comprises IR sensor 160, video processor 210, MPEG2 encoder 220, hard disk drive 230,
30 MPEG2 decoder/NTSC encoder 240, and video recorder (VR) controller 250. Video playback device 150 further comprises frame grabber 260, closed captioned detector 270, and closed captioned memory (or buffer) 280. VR controller 250 directs the overall operation of video playback device 150, including View mode, Record mode, Play mode, Fast Forward (FF) mode, Reverse mode, among others.

In View mode, VR controller 250 causes the incoming television signal from the cable service provider to be demodulated and processed by video processor 210 and transmitted to television set 105, without storing or retrieving from hard disk drive 230. Video processor 210, which may be, for example, a TriMedia (TM) 1100 media processor, contains radio frequency (RF) front-end circuitry for receiving incoming television signals from the cable service provider, tuning to a user-selected channel, and converting the selected RF signal to a baseband television signal (e.g., super video signal) suitable for display on television set 105. Video processor 210 also is capable of receiving a conventional NTSC signal from MPEG2 decoder/NTSC encoder 240 and video frames from CC memory 280 and transmitting a baseband television signal (e.g., super video signal) to television set 105.

In Record mode, VR controller 250 causes the incoming television signal to be stored on hard disk drive 230. Under the control of VR controller 250, MPEG2 encoder 220 receives the incoming television signal from the cable service provider and converts the received RF signal to MPEG format for storage on hard disk drive 230. In Play mode, VR controller 250 directs hard disk drive 230 to stream the stored television signal (i.e., program) to MPEG2 decoder/NTSC encoder 240, which converts the MPEG2 data from hard disk drive 230 to, for example, a super video (S-Video) signal that video processor 210 transmits to television set 105.

It should be noted that the choice of the MPEG2 standard for MPEG2 encoder 220 and MPEG2 decoder/NTSC encoder 240 is by way of illustration only. In alternate embodiments of the present invention, the MPEG encoder and decoder may comply with one or more of the MPEG-1, MPEG-2, MPEG-4, and MPEG-7 standards.

For the purposes of this application and the claims that follow, hard disk drive 230 is defined to include any mass storage device that is both readable and writable, including conventional magnetic disk drives and optical disk drives for read/write digital versatile disks (DVD-RW), re-writable CD-ROMs, VCR tapes and the like. In fact, hard disk drive 230 need not be fixed in the conventional sense that is permanently embedded in video playback device 150. Rather, hard disk drive 230 includes any mass storage device that is dedicated to video playback device 150 for the purpose of storing recorded video programs. Thus, hard disk drive 230 may include an attached peripheral drive or removable disk drives (whether embedded or attached), such as a juke box device that holds read/write DVDs or re-writable CD-ROMs. Furthermore, in an advantageous embodiment of the present invention, hard disk drive 230 may include external mass storage devices that video playback device 150 may access and control via a network connection (e.g., Internet protocol (IP))

connection), including, for example, a disk drive in the user's home personal computer (PC) or a disk drive on a server at the user's Internet service provider (ISP).

During Play mode, VR controller 250 may receive a Fast Forward (FF) or Reverse command from a user via IR sensor 160. In FF or Reverse modes, video playback device 150 is capable of displaying closed caption (CC) text in a CC window on television screen 110 using frame grabber 260, closed caption (CC) detector 270, and closed caption (CC) memory 280. When a FF or reverse command is received, VR controller 250 causes hard disk drive 230 and MPEG2 decoder/NTSC encoder 240 to play video at a faster forward speed or in reverse, accordingly. However, VR controller 250 also directs video processor to stop receiving the output of MPEG2 decoder/NTSC encoder 240 as a source of the video signal. Instead, MPEG2 decoder/NTSC encoder 240 is switched to receive the video frames from the output of CC memory 280 as the source of the video signal.

Frame grabber 260 captures and stores video frames from the output of MPEG2 decoder/NTSC encoder 240. CC detector 270 detects CC text in the NTSC output signal of MPEG2 decoder/NTSC encoder 240. CC text is typically inserted in the blanking interval at the end of line 21 of the video signal. As will be explained below in greater detail, CC detector 270 uses a time stamp associated with each line of CC data to identify a selected key frame of video corresponding to the CC text. CC detector 270 stores each line of CC text and the time stamp in CC memory 280 and causes frame grabber 260 to store the selected video frame for each line of CC text in CC memory 260. Thereafter, the key frames and the CC text are transferred to video processor 210 according to the speed and play back direction (FF or Reverse) selected by the user. Video processor 210 plays the key frames as a sequence of still frames that appear on television screen 110 contemporaneously with the corresponding CC text.

FIGURE 3 illustrates television screen 110 on which closed caption text and associated video frames are displayed according to one embodiment of the present invention. Television screen 110 displays video frames 310 and 315 in pairs, labeled Frame A and Frame B respectively, in a top portion of television screen 110. Closed caption text scrolls in CC text window 305 in a bottom portion of television screen 110. The display position of the frames is arbitrary and the frames and text window may be located at any predetermined location on television screen 110.

The CC text lines scroll in CC text window 305 may scroll at different speeds and each line is synchronized with an appropriate key frame according to a synchronization scheme (e.g., synchronizing key frames and CC text to match time stamps of CC text and key

frames). Depending on whether the mode is forward or reverse, the frames are moved from one side of the screen to the other and a new frame is loaded as the CC text scrolls. By displaying two key frames at a time, continuity is provided in the video display and there is an efficient use of screen space.

5 In the present embodiment, the user presses the Fast Forward or Reverse (or Rewind) buttons several times to indicate fast forward or rewind speed. Time stamp data for each line of CC text is used to determine which frame to display for that line of CC text. A specific key frame may be picked with a fixed sampling rate or the key frame may be selected from a predetermined list of key frames with a "nearest-neighbor" scheme. If the user presses "Pause" during FF or reverse modes, the current video frames in Frame A and Frame B are maintained during the pause period. Similarly, closed caption text scrolling in CC text window 305 is held frozen when the user presses "Pause."

FIGURE 4 illustrates the contents of closed caption memory 280 in exemplary video playback device 150 according to one embodiment of the present invention. Closed caption (CC) memory 280 stores N lines of closed caption text, including exemplary closed caption lines 401-404, which are labeled CC Line 1, CC line 2, CC Line 3, and CC Line N. CC memory 280 also stores N time stamps, including exemplary times stamps 411-414, which are labeled TS1, TS2, TS3 and TSN respectively. Finally, CC memory 280 stores N key frames, including exemplary key frames 421-424, which are labeled Key Frame 1, Key Frame 2, Key Frame 3 and Key Frame N, respectively.

TS1 and Key Frame 1 are the time stamp and the key frame that correspond to CC Line 1. TS2 and Key Frame 2 are the time stamp and the key frame that correspond to CC Line 2. TS3 and Key Frame 3 are the time stamp and the key frame that correspond to CC Line 3. Finally, TSN and Key Frame N are the time stamp and the key frame that correspond to CC Line N.

Referring now to FIGURE 5, a flow diagram 500 illustrates the operation of exemplary video playback device 150 according to one embodiment of the present invention. VR controller 250 is depicted as receiving a fast forward command from a user's playback device 150 remote control (process step 505). Frame grabber 260 then begins storing all video frames from the video media. Additionally, CC detector 270 detects closed caption text from the video signal that corresponds to the video frames being stored (process step 510).

Key frames are then selected from the stored video frames and stored in CC memory 280. In addition to the key frames, CC text lines and time stamps for both text lines

and key frames are stored in CC memory 280 (process step 515). Video processor 210 begins displaying one or more key frames along with corresponding CC text on TV screen 110 at a speed and play back direction determined by user inputs on the user's remote control (process step 520).

- 5 At least two frames for displaying video are presented on a television or display screen. In another predetermined position on the screen, a frame is positioned to display speech, from the frames, in the form of readable text. The frames are selected frames and the text is speech that corresponds to the frames that are displayed. By selecting key frames and text for display, the problem associated with scrolling all the frames in a
- 10 recording to find a particular spot is reduced dramatically.

Although the present invention has been described in detail, those skilled in the art should understand that they can make various changes, substitutions and alterations herein without departing from the spirit and scope of the invention in its broadest form.

CLAIMS:

1. For use in a video playback device, an apparatus for displaying closed caption text during fast forward mode and rewind mode on a display screen coupled to the video playback device, said apparatus comprising:
 - a video frame grabber (260) capable of capturing a plurality of video frames
 - 5 from a played-back video signal during fast forward mode and reverse mode;
 - a closed caption text detector (270) capable of detecting closed caption text in said played-back video signal;
 - a memory (280) for storing said detected closed caption text and a plurality of key frames, said key frames comprising selected ones of said plurality of video frames
 - 10 captured by said video frame grabber (260) corresponding to said detected closed caption text; and
 - a video processor (210) capable of retrieving from said memory (280) a first line of closed caption text and at least one key frame corresponding to said first line of closed caption text and displaying said first line of closed caption text and said at least one key
 - 15 frame on said display screen (105).
2. The apparatus as set forth in Claim 1 wherein said video processor (210) is capable of displaying a plurality of lines of closed caption text in a selected window on said display screen (105).
- 20 3. The apparatus as set forth in Claim 2 wherein said video processor (210) is capable of scrolling said plurality of lines of closed caption text in said selected window on said display screen (105).
- 25 4. The apparatus as set forth in Claim 1 wherein said video processor (210) is capable of displaying a first key frame in a first portion of said display screen (105) and a second key frame in a second portion of said display screen (105).

5. The apparatus as set forth in Claim 4 wherein said video processor (210) is capable of displaying said first key frame in said first portion of said display screen (105) when said first line of closed caption line text appears in a selected window on said display screen (105).

5

6. The apparatus as set forth in Claim 5 wherein said video processor (210) is capable of displaying said first key frame in said second portion of said display screen (105) when said first line of closed caption line text scrolls to a new position in said selected window on said display screen (105).

10

7. The apparatus as set forth in Claim 1 wherein said video processor (210) is capable of displaying lines of closed caption text and key frames on said display screen (105) at a variable rate determined by commands received from a user of said video play back device.

15

8. A video play back device comprising:
a storage device capable of storing thereon a plurality of video signals;
video playback circuitry capable of retrieving a first selected video signal stored on said storage device and generating therefrom a played-back video signal capable of being displayed on a display screen (105) coupled to said video play back device;
20 said video playback device further comprising an apparatus as set forth in Claim 1.

20

9. For use in a video playback device, a method for displaying closed caption text during fast forward mode and rewind mode on a display screen (105) coupled to the video playback device, the method comprising the steps:

25

capturing a plurality of video frames from a played-back video signal during fast forward mode and reverse mode;

detecting closed caption text in the played-back video signal;

storing in a memory (280) the detected closed caption text and a plurality of

30

key frames, the key frames comprising selected ones of the captured plurality of video frames corresponding to the detected closed caption text; and

retrieving from the memory (280) a first line of closed caption text and at least one key frame corresponding to the first line of closed caption text and displaying the first line of closed caption text and the at least one key frame on the display screen (105).

10. The method as set forth in Claim 9 wherein said video processor (210) is capable of displaying a plurality of lines of closed caption text in a selected window on said display screen (105).

5

11. The method as set forth in Claim 10 further comprising the step of scrolling said plurality of lines of closed caption text in said selected window on said display screen (105).

10 12. The method as set forth in Claim 9 further comprising the step of displaying a first key frame in a first portion of said display screen (105) and a second key frame in a second portion of said display screen (105).

13. The method as set forth in Claim 12 further comprising the step of displaying
15 said first key frame in said first portion of said display screen (105) when said first line of closed caption line text appears in a selected window on said display screen (105).

14. The method as set forth in Claim 13 further comprising the step of displaying
20 said first key frame in said second portion of said display screen (105) when said first line of closed caption line text scrolls to a new position in said selected window on said display screen (105).

15. The method as set forth in Claim 9 further comprising the step of displaying
25 lines of closed caption text and key frames on said display screen (105) at a variable rate determined by commands received from a user of said video play back device.

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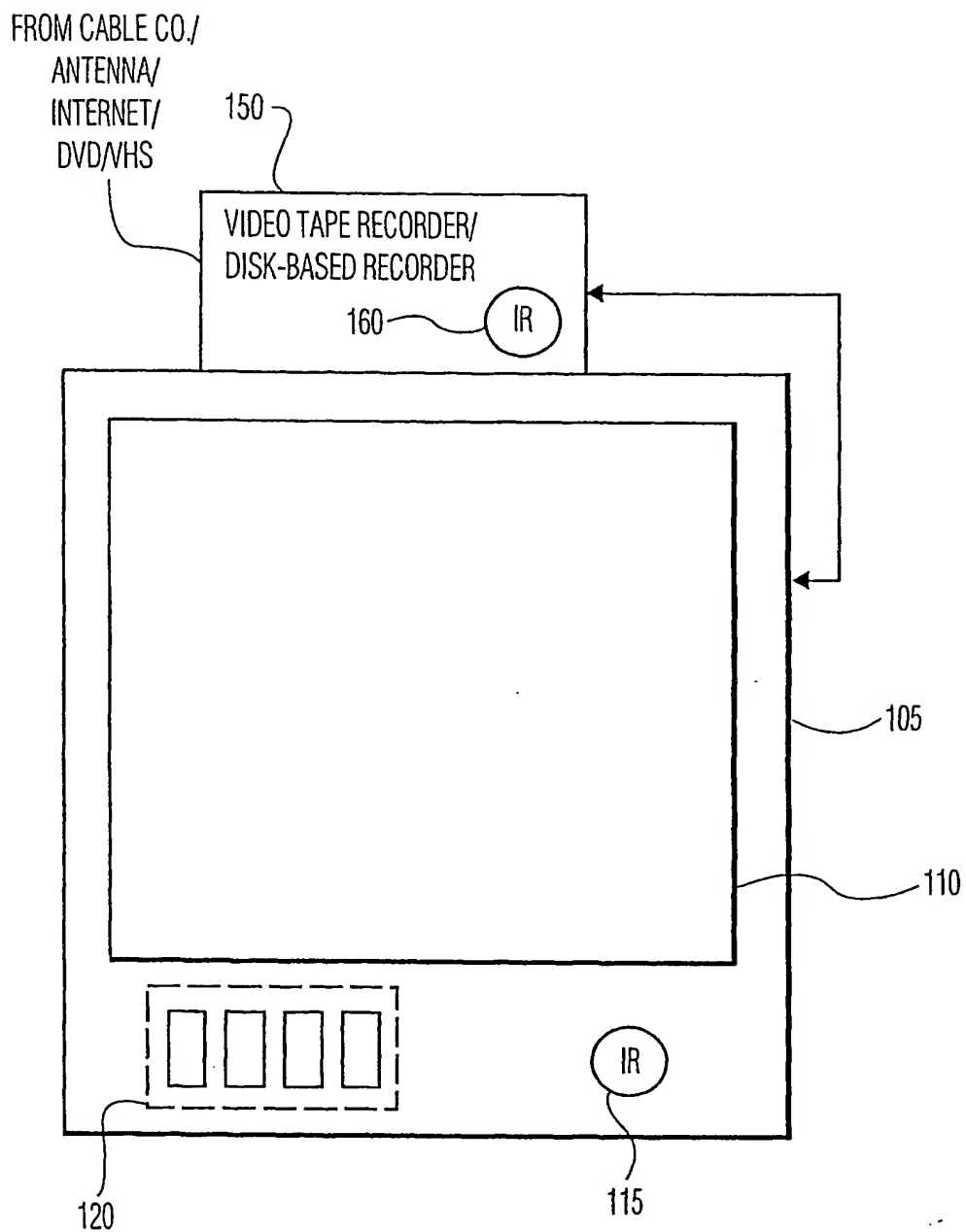


FIG. 1

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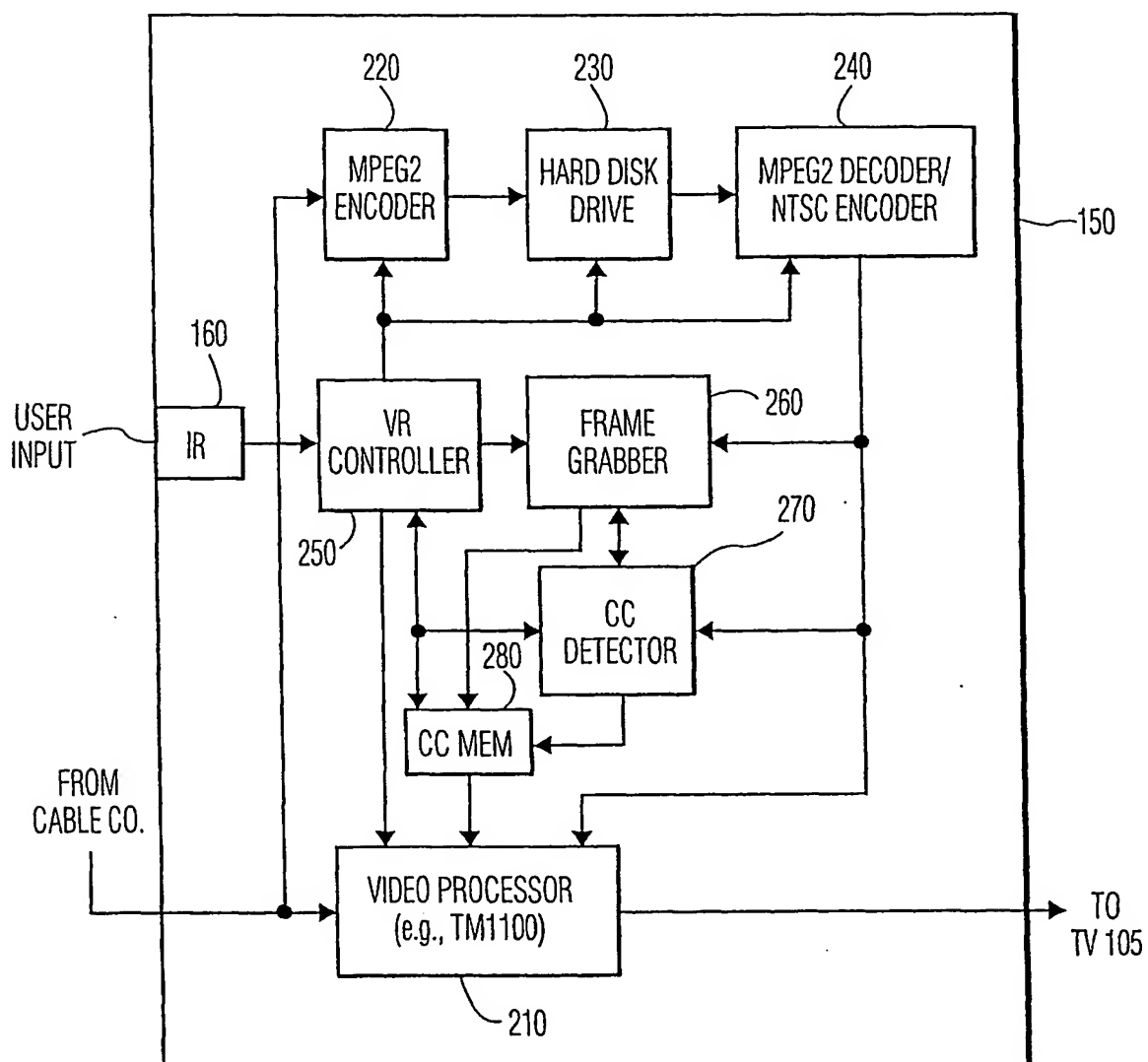


FIG. 2

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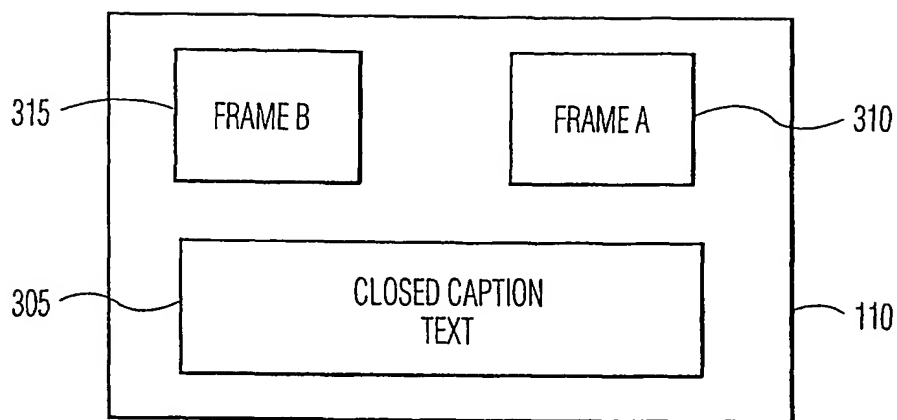


FIG. 3

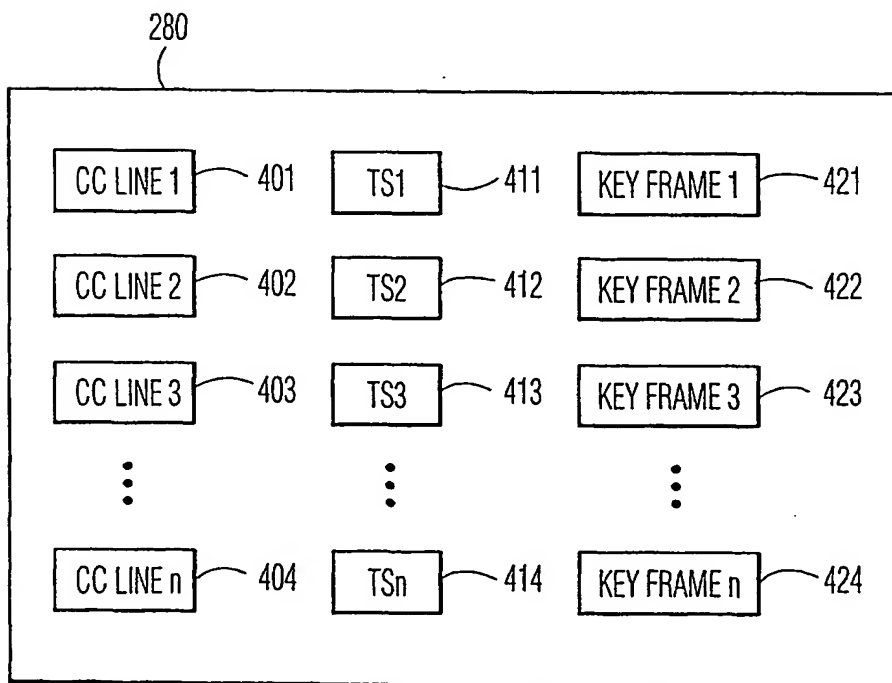


FIG. 4

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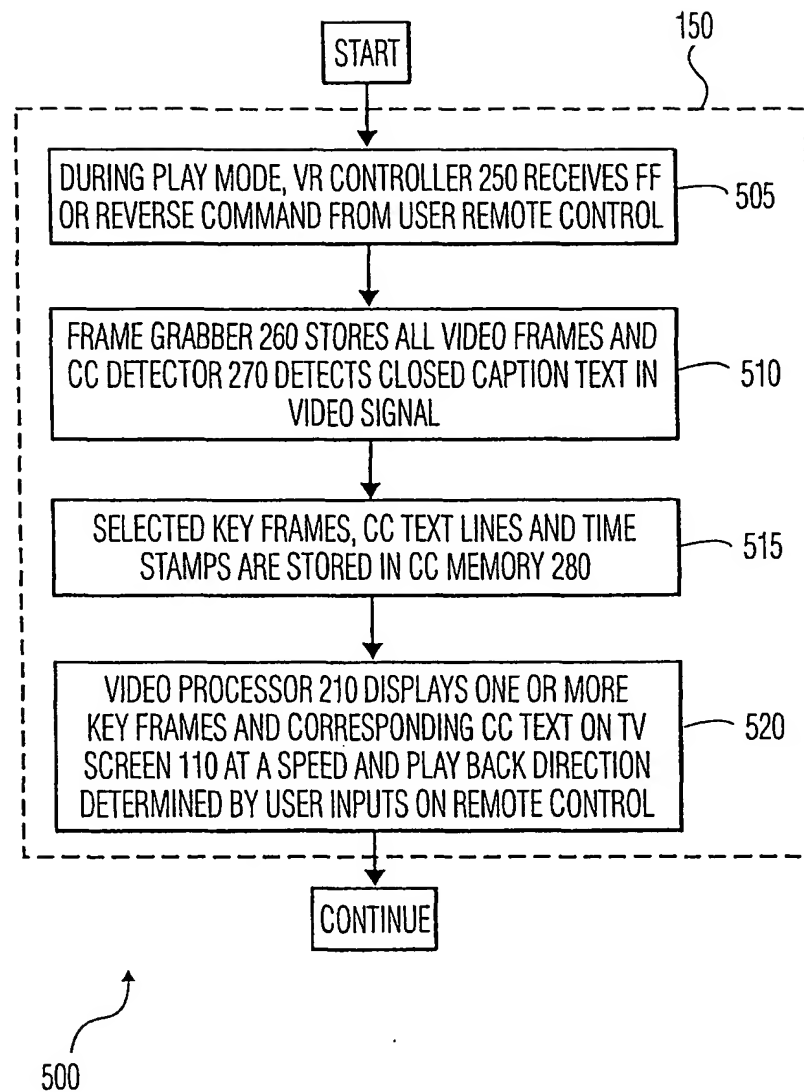


FIG. 5

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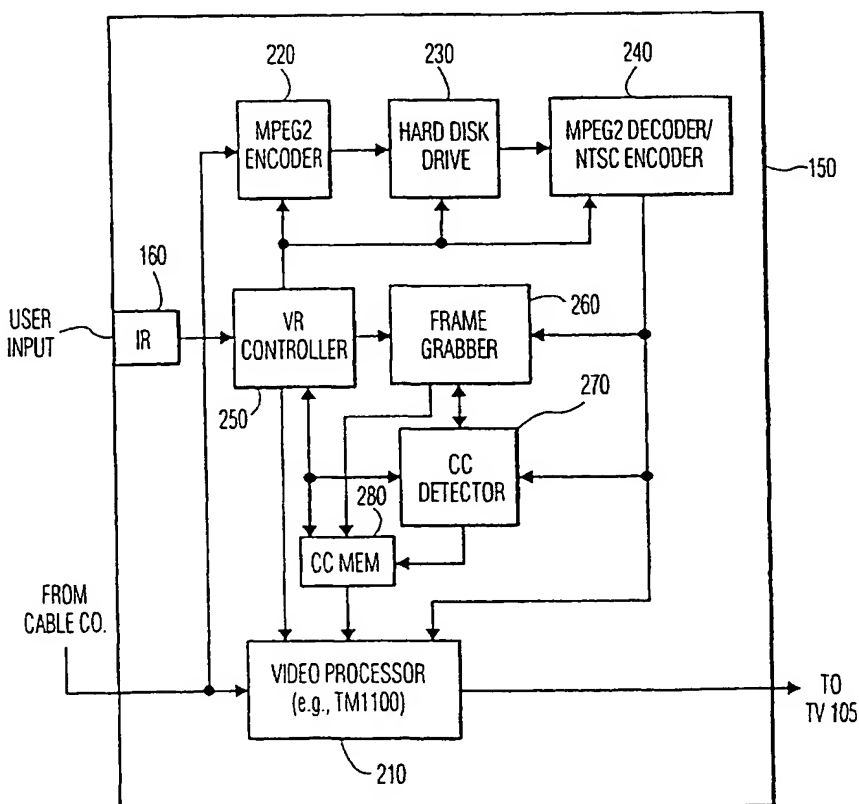
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- (71) Applicant: **KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]: Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).** (88) Date of publication of the international search report: **27 June 2002**
- (72) Inventor: **DAGTAS, Serhan; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).** *For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: **SYSTEM AND METHOD FOR PLAYBACK OF VIDEO WITH CLOSED CAPTIONED TEXT**



(57) Abstract: There is disclosed a video frame grabber (260) capable of capturing a plurality of video frames from a played-back video signal during fast forward mode and reverse mode. A closed caption text detector (270) is provided that is capable of detecting closed caption text in the played-back video signal. A memory (280) is provided for storing the detected closed caption text and a plurality of key frames. The key frames comprise selected ones captured by the video frame grabber (260) corresponding to detected closed caption text. A video processor (210) retrieves a line of closed caption text and at least one key frame corresponding to the first line of closed caption text and displays the line of closed caption text with the key frame on the display screen.

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 01/11157

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N5/783

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 757 484 A (SONY CORPORATION) 5 February 1997 (1997-02-05) page 7, line 52 -page 9, line 36; figures 1-4B -----	1,9

☐

Further documents are listed in the continuation of box C.

☒

Patent family members are listed in annex.

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- *G* document member of the same patent family

Date of the actual completion of the international search

2 April 2002

Date of mailing of the international search report

09/04/2002

Name and mailing address of the ISA

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